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PATENT APPLICATION

AF #

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IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Ronald D. Larson

Confirmation No.:

Application No.: 09/172,389

Examiner: Nguyen, K.

Filing Date: 10/14/98

Group Art Unit: 2671

Title: A Method and Apparatus for Updating A Hierarchical Z Buffer

COMMISSIONER FOR PATENTS
Washington, D.C. 20231

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith in **triplicate** is the Appeal Brief in this application with respect to the Notice of Appeal filed on **9/21/01**.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $310.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

( ) (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

( )	one month	$110.00
( )	two months	$390.00
( )	three months	$890.00
( )	four months	$1390.00

( ) The extension fee has already been filled in this application.

(X) (b) Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **08-2025** the sum of $320.00. At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account **08-2025** pursuant to 37 CFR 1.25.

(X) A duplicate copy of this transmittal letter is enclosed.

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Respectfully submitted,

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#13
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:	Ronald D. Larson		
Serial No.:	09/172,389	Art Unit:	2671
Filed:	October 14, 1998	Examiner:	Nguyen, K.
For:	A METHOD AND APPARATUS FOR UPDATING A HIERARCHICAL Z BUFFER	HP Dkt. No.:	10981013-1
		TKHR Dkt. No.:	50814-1040

APPEAL BRIEF UNDER 37 C.F.R. §1.192

Assistant Commissioner for Patents
Box: AF (Appeal Brief)
Washington, DC 20231

Sir:

This Appeal Brief under 37 C.F.R. §1.192 is submitted in triplicate in support of the Notice of Appeal filed September 21, 2001, responding to the Final Office Action of June 22, 2001.

It is not believed that extensions of time or fees for net addition of claims are required beyond those, which may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefor (including fees for net addition of claims) are hereby authorized to be charged to Hewlett-Packard Company's Deposit Account No. 08-2025.

Certificate of Mailing

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Signature: Sara Rogers

I. REAL PARTY IN INTEREST

The real party in interest is the assignee, Hewlett-Packard Company, which assignment was recorded on June 15, 1999, on reel 010019, at frame 0432.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences that will affect or be affected by a decision in this appeal.

III. STATUS OF CLAIMS

Claims 1, 4-11, and 14-18 stand finally rejected. No claims have been allowed. The final rejection of claims 1, 4-11, and 14-18 is appealed.

IV. STATUS OF AMENDMENTS

This application was originally filed on October 14, 1998, with claims 1-20. In a Third Response filed August 14, 2001, Applicant attempted to amend claims 1, 11, and 18. However, in an Advisory Action, the Examiner refused to enter the claim amendments, stating that at least one raised new issues. The claims in the attached Appendix reflect the state of the claims before the submission of the Third Response.

The final rejection of claims 1, 4-11, and 14-18 is appealed.

V. SUMMARY OF THE INVENTION

Applicant's independent claims 1, 11, an 18 describe a method and apparatus for occlusion testing primitives being processed in a graphics system (20) and for updating a Z pyramid data structure (71, 79, 85, and 93) used for occlusion testing on the fly. The

apparatus (40) comprises logic (57) configured to create the Z pyramid data structure (71, 79, 85, and 93) and to perform occlusion testing.

Preferably, the primitives are occlusion tested in a tiler component (57) of the graphics system (20) and the Z pyramid data structure (71, 79, 85, and 93) is updated by the tiler component (57) on the fly as primitives are being processed through the graphics system (20). The Z pyramid data structure (71, 79, 85, and 93) may be stored in a Z pyramid memory element (63), which is in communication with the tiler (57). The Z pyramid memory element (63) is periodically updated with pixel level Z values, *i.e.*, with Z values of primitives, which have been scan converted into screen coordinates corresponding to locations on the display monitor (21). In this way, the Z pyramid data structure (71, 79, 85, and 93) can be updated on the fly and can be periodically updated with pixel level Z values to ensure accurate occlusion testing.

VI. ISSUES

The following issues need to be decided as part of this appeal:

1. Whether claims 1, 4-7, 11, and 14-18 are patentable over the combination of U.S. Patent Number 5,579,455 to *Greene et al.* in view of U.S. Patent Number 6,088,035 to *Sudarsky*.

2. Whether claims 8-10 are patentable over the combination of U.S. Patent Number 5,579,455 to *Greene et al.* in view of U.S. Patent Number 6,088,035 to *Sudarsky* in further view of U.S. Patent 5,600,763 to *Greene et al.*

3. Whether the rejection of claims 1, 4-11, and 14-18 is proper as a matter of law or whether the Office Action failed to cite a legally proper suggestion or motivation to combine the references cited to reject these claims.

VII. GROUPING OF CLAIMS

With respect to claims 1, 4-11, 14-18, the claims of the group do not stand or fall together, but rather:

I. Claims 1 and 4-7 stand or fall as a group (Group I) with respect to the rejections over the combination of *Greene et al.* ('455) and *Sudarsky* for at least the reason that the combination fails to disclose, teach, or suggest, either alone or in combination, determining whether the tested primitive is not fully occluded and if not, replacing the Z value for the subregion with the maximum Z value of the primitive, as recited in independent claim 1.

II. Claims 8-10 stand or fall as a group (Group II) with respect to the rejections over the combination of *Greene et al.* ('455) and *Sudarsky* in further view of U.S. Patent Number 5,600,763 to *Greene* for at least the reason that the combination fails to disclose, teach, or suggest that primitives are occlusion tested in a tiler component of the graphics system and wherein the Z pyramid data structure is updated by the tiler component on the fly as primitives are being processed through the graphics system.

III. Claims 11 and 14-17 stand or fall as a group (Group III) with respect to the rejections over the combination of *Greene et al.* ('455) and *Sudarsky* for at least the reason that the combination fails to disclose, teach, or suggest if a determination is made that the maximum Z value of the primitive is less than the Z value for the covered subregion, replacing the Z value for the subregion with the maximum Z value of the primitive.

IV. Claim 18 stands or falls as a group (Group IV) with respect to the rejections over the combination of *Greene et al.* ('455) and *Sudarsky* for at least the reason that the combination fails to disclose, teach, or suggest wherein if said comparing means determines that the maximum Z value of the primitive is less than the Z value for the

covered subregion, then said comparing means replaces the Z value for the subregion with the maximum Z value of the primitive.

VIII. THE ARGUMENT

The Applicant respectfully appeals the rejection of claims 1, 4-11, and 14-18 in the Final Office Action for at least the following reasons.

First, both *Greene et al.* and *Sudarsky* fail to teach the claimed invention.

Second, the combination of *Greene et al.* and *Sudarsky* is improper because the Office Action fails to state why it would have been obvious to combine the apparatus of *Greene et al.* ('455) (a method that updates a Z pyramid after scan conversion) with the temporal bounding volumes of *Sudarsky* (a method that does not use a Z pyramid) to make the claimed invention.

Third, the Final Office Action rejections of claims 4-7, 9-11, and 14-18 citing the combinations of *Greene et al.* and *Sudarsky* and the rejection of claim 8 citing the combination of *Greene et al.* ('455) and *Sudarsky* in further view of *Greene et al* ('763) fail for at least the same reasons that the combination of *Greene et al.* ('455) and *Sudarsky* fail. Stated another way, the cited combination fails to cure the underlying defects of *Greene et al.* ('455) and *Sudarsky*. Consequently, the proposed combination of *Greene et al.* ('455) and *Sudarsky* fails to disclose, teach, or suggest all features of claims 1, 4-7, 9-11, and 14-18. Furthermore, the proposed combination of *Greene et al.* ('455), *Sudarsky*, and *Greene* ('763) fails to disclose, teach, or suggest all features of claim 8.

In order for a claim to be properly rejected under 35 U.S.C. §103, the combined teachings of the prior art references must suggest all features of the claimed invention to one of ordinary skill in the art. *See, e.g., In Re Dow Chemical*, 837 F.2d 469, 5 U.S.P.Q.2d 1529, 1531 (Fed. Cir. 1988); and *In re Keller*, 208 U.S.P.Q.2d 871, 881 (C.C.P.A. 1981).

Furthermore, an Office Action, in order to formulate a valid and complete rejection under 35 U.S.C. § 103(a), must cite the specific teaching within the prior art that suggests a desirability to combine the references. In order for a claim to be properly rejected under 35 U.S.C. § 103, "[t]he PTO has the burden under section 103 to establish a *prima facie* case of obviousness. It can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references." *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988). Accordingly, as a matter of law, the rejection in the present instance is improper.

Discussion of Claim Group I

Claim 1

Claim 1 presently stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent Number 5,579,455 to *Greene et al.* in view of U.S. Patent Number 6,088,035 to *Sudarsky*. Claim 1 recites:

> 1. An apparatus for occlusion testing primitives being processed in a graphics system, each primitive having a minimum Z value and a maximum Z value, the apparatus comprising:
>
> logic configured to create a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level, said logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded, wherein if a determination is made that the tested primitive is not fully occluded, said logic determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if said logic determines that a subregion is fully covered by the tested primitive,

then said logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive, wherein said logic to determines whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion, ***wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive.***

(Emphasis Added.)

Accordingly, Applicant's claim defines an apparatus for occlusion testing primitives being processed in a graphics system. A Z pyramid memory element is used to store a Z pyramid data structure that permits occlusion testing while primitives are being processed by the graphics system. The Z pyramid memory element is periodically updated with pixel level Z values, *i.e.*, with Z values of primitives, which have been scan converted into screen coordinates corresponding to locations on the display monitor. In this way, the Z pyramid data can be updated on the fly and can be periodically updated with pixel level Z values to ensure accurate occlusion testing. Notably, the other independent claims present in the case, claims 11 and 18, contain similar recitations regarding the processing of Z pyramid data.

In fact, the Office Action rejection for claims 1, 11, and 18 alleges:

> Greene et al. discloses creating a Z pyramid data structure (col. 5, lines 51 - 52), the z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions (col. 5, lines 51- 65), each region comprising subregions (col. 26, lines 38 - 39), each subregion corresponding to a single Z value (col. 26, lines 39 - 45), each region corresponding to a plurality of Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level (col. 26, lines 47 - 51), the logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded (col. 26, lines 61 - 67); if the tested primitive is not fully occluded, the logic determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if a subregion is fully covered by the tested

> primitive, then the logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive (col. 19, lines 44-49, FIG. 12); the logic of Greene determines whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive, the logic determines whether the maximum Z value of the tested primitive is less than the Z value (nearer than the current depth value) for the covered subregion, if the maximum Z value is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value (col. 19, lines 50-53); further Sudarsky discloses updating the potentially visible dynamic object list as previously hidden dynamic objects become visible, and hidden.

The Final Office Action then states, in a conclusory manner,

> It would have been obvious to one of ordinary skill in the art to incorporate Sudarsky's teaching into Greene's method for updating the occluded dynamic object during the time period (on the fly), providing an improved method for displaying graphics models which adapts visibility culling algorithms to dynamic scenes, and also minimizes the update overhead of the model that may be potentially visible to the user.

Applicant respectfully traverses this rejection.

Applicant respectfully asserts that the combination of *Greene et al.* in view of *Sudarsky* is inadequate to render claim 1 obvious. In particular, both *Greene et al.* and *Sudarsky* fail to teach the claimed invention. Importantly, neither *Greene et al.* nor *Sudarsky* discloses, teaches or suggests, either alone or in combination, "***wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive.***" as recited in independent claim 1.

Greene et al. does not disclose or teach these limitations because the approach used by *Greene et al.* does not provide a mechanism that is capable of updating the Z pyramid as primitives are being processed through the graphics pipeline, which is what the emphasized language of claim 1 describes.

The *Greene et al.* patent ('455) cited by the Final Office Action appears to be directed to the same invention that is described in the article by *Greene et al.* discussed in the "Background of the Invention" in the present application. Both the article and the '455 patent disclose utilizing cubes to perform the Z-pyramid comparison tests and performing the Z comparison tests beginning at the top of the pyramid and moving downwards towards the bottom of the pyramid until a determination is made that a cube is either fully occluded or it is determined to be at least partially visible.

In essence, in *Greene et al.*, once the Z pyramid has been constructed, the Z values for the primitives making up the faces of the cubes are compared beginning at the highest level of the pyramid and working down towards the base of the pyramid. For each primitive of a face of a cube, the minimum Z value of the primitive is tested against the levels of the pyramid in a top-to-bottom sequence. If the minimum Z value for the primitive is greater than the pyramid Z value, then the primitive is fully occluded. If all of the primitives making up all of the faces of the cube are occluded, the cube is occluded and can be discarded. If not, the process continues to the next level of the pyramid. At each level of the pyramid, the process is performed until a determination is made that the cube is either fully occluded or until the process reaches the level in the Z pyramid at which a primitive is found to be at least partially visible.

As stated in the "Background of the Invention" in the present application, the approach described in *Greene et al.* enables a plurality of primitives to be simultaneously tested instead of individually testing each primitive. However, the approach of *Greene et al.* does not make any provision for updating the Z pyramid as primitives are being processed through the graphics pipeline. Once a determination is made that a cube contains a visible primitive, the visible primitive must be scan converted to the pixel level before the Z buffer can be updated and the Z pyramid can be reconstructed. *Greene et al.* only makes a

provision for marking the rendered (*i.e.*, scan converted) primitives to avoid scan converting them more than once. (See Col. 5, lines 30-37). All of the algorithms described in *Greene et al.* require that each face of each cube be scan converted in order to determine whether the cube is hidden. Therefore, the algorithms inherently require that scan conversion be performed before the Z pyramid can be updated.

In contrast, the present invention enables the Z buffer to be updated and the Z pyramid to be reconstructed prior to scan conversion. In accordance with the present invention, as described in independent claim 1, each region corresponds to a plurality of Z values and has a maximum region Z value, which corresponds to the largest Z value of the region. The minimum Z value of each primitive is compared with the Z value of a region associated with the primitive to determine whether the primitive is fully occluded. If a determination is made that the primitive is not fully occluded, then a subsequent determination is made as to whether any subregion of the region associated with the primitive is fully covered by the primitive. If the result indicates that a subregion is fully covered by the primitive, then the logic determines whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive. If so, the Z pyramid is updated accordingly. Thus, the Z pyramid is immediately updated, rather than waiting until primitives have been scan converted. This, in turn, expedites the Z comparison tests and improves the overall performance of the computer-graphics display system.

Furthermore, *Sudarsky* does not disclose or teach the above emphasized language in claim 1 because it is not related to the field of updating a hierarchical Z buffer in a graphics system of a computer graphics display system. Rather, *Sudarsky* appears to disclose a method for rendering a 3-dimensional graphics scene made up of a plurality of static and/or dynamic objects composed of geometrical elements. The method appears to predict a time period during which each of the dynamic objects are expected to remain occluded; generating

a volume that contains the dynamic object; inserting the volume into a spatial data structure used by an occlusion technique; applying the occlusion culling technique so as to output sensitively render the scene, yet not rendering or updating the occluded dynamic object during the time period, provided the occlusion culling technique does not find the volume to be visible. (See *Sudarsky*, Col. 2, line 64 – Col. 3, line 2; Col. 3, line 44 – Col. 4, line 12; Col. 4, line 61 – Col. 5, line 13).

In contrast to the Applicant's claimed invention, the temporal bounding volumes of *Sudarsky* are calculated on the fly as opposed to the Z pyramid calculations. In this way, *Sudarsky* assures compatibility with interactive applications in which this information is not available in advance, such as simulations, games, and virtual reality.

As identified above in reference to independent claim 1, neither *Greene et al.* nor *Sudarsky* disclose, teach or suggest, "***wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive.***" as defined in Applicant's independent claim 1. In that *Sudarsky* does not remedy this deficiency of the *Greene et al.* reference, Applicant respectfully submits that independent claim 1 patently defines over the prior art of record and is allowable. Applicant respectfully asserts that the rejection to claim 1 is improper and requests that this rejection be overturned.

Claims 4-7

Since claim 1 is allowable, as argued above, pending dependent claims 4-7 are allowable as a matter of law since they contain all features of their respective independent claim. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

The Office's Proposed Prior Art Combination Is Improper

In connection with the above-discussion, yet forming a separate and independent basis for the patentability of the claims of Claim Group I, the Final Office Action failed to cite a proper teaching, suggestion or motivation, to alter the *Greene et al.* system in such a way as to render the presently-claimed invention unpatentable.

As acknowledged by the Court of Appeals for the Federal Circuit, the U.S. Patent and Trademark Office ("USPTO") has the burden under section 103 to establish a *prima facie* case of obviousness by showing some objective teaching in the prior art or generally available knowledge of one of ordinary skill in the art that would lead that individual to the claimed invention. See *In re Fine*, 837, F.2d 1071, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). Accordingly, to make a *prima facie* case for obviousness, there must be some prior art teaching or established knowledge that would suggest to a person having ordinary skill in the pertinent art to fill the voids apparent in the applied reference. It is respectfully asserted that no such *prima facie* case has been made in the outstanding Office action.

In this regard, the Final Office Action has wholly failed to cite a proper suggestion, teaching, or other motivation to modify the teachings of *Greene* in such a way as to disclose the Applicant's presently-claimed invention. Instead, the Final Office Action has merely stated, in conclusory fashion, that

> it would have been obvious to a person of ordinary skill in the art at the time the invention was made to incorporate Sudarsky's teaching into Greene's method for updating occluded dynamic object during the time period (on the fly), providing an improved method for displaying graphics models which adapts visibility culling algorithms to dynamic scenes.

There is nothing in *Greene* or in *Sudarsky* that suggest that *Greene's* hierarchical Z-buffer scan-conversion algorithm that marks the rendered *(i.e.,* scan converted) primitives to avoid scan converting them more than once would be applicable to a graphics system that

performs Z pyramid calculations as primitives are being processed by the system as in the present independent claims. Furthermore, there is no suggestion in *Sudarsky*, which apparently teaches temporal bounding volumes that are calculated on the fly might be adapted to perform Z pyramid calculations. Significantly, *Sudarsky* does not use a Z pyramid as recited in the present independent claims. Absent such motivation, the combination of *Greene* and *Sudarsky* is improper. Moreover, there is no suggestion in *Greene et al.* ('763) that the anti-aliasing method might be adapted to perform Z pyramid calculations as recited in the pending independent claims.

An Applicant's disclosure or specification cannot be used as a road map for forming a § 103(a) rejection. It is well settled law that in order to properly support an obviousness rejection under 35 U.S.C. § 103(a), there must have been some teaching *in the prior art* to suggest to one skilled in the art that the claimed invention would have been obvious. *W. L. Gore & Associates, Inc. v. Garlock Thomas, Inc.*, 721 F.2d 1540, 1551 (Fed. Cir. 1983). More significantly,

> "The consistent criteria for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that this [invention] should be carried out and would have a reasonable likelihood of success, viewed in light of the prior art . ..." **Both *the suggestion and the expectation of success must be founded in the prior art, not in the applicants' disclosure...*** In determining whether such a suggestion can fairly be gleaned from the prior art, the full field of the invention must be considered; for the person of ordinary skill in the art is charged with knowledge of the entire body of technological literature, including that which might lead away from the claimed invention."

(Emphasis added.) In re Dow Chemical Company, 837 F.2d 469, 473 (Fed. Cir. 1988).

The Federal Circuit has repeatedly stated, "the inquiry is not whether each element existed in the prior art, but whether the prior art made obvious the invention as a whole for which patentability is claimed." *Hartness International, Inc. v. Simplimatic Engineering*

Co., 819 F.2d 1100, 1108, 2 U.S.P.Q.2d 1826 (Fed. Cir. 1987). "The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification." *In re. Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984). "Modification unwarranted by the disclosure of a reference is improper." *Carl Schenck, A. G. v. Nortron Corp.*, 713 F.2d 782, 218 U.S.P.Q. 698, 702 (Fed. Cir. 1983). In this regard, "[t]he mere fact that the prior art may be modified in the manner suggested by the [Office action] does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266, 23 U.S.P.Q.2d 1780 (Fed Cir. 1992).

Irrespective of the clear lack of motivation to combine the *Greene* and *Sudarsky* references, Applicant asserts that the rejection is improper because, even if the teachings of the two references were properly combinable, such combination would not result in the Applicant's claimed invention as amended above. *Greene* and *Sudarsky* simply fail to teach, disclose or suggest, "***wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive.***" as found in the independent claim 1. Consequently, the combination of *Greene et al.* and *Sudarsky* simply would not result in Applicant's claimed invention as amended above.

In summary, it is the Applicant's position that a *prima facie* case for obviousness has not been made against Applicant's claim 1. In addition, as a result of their dependence from independent claim 1, a *prima facie* case for obviousness has not been made against Applicant's claims 4 through 7, which depend from claims 1. Therefore, it is respectfully submitted that each of the pending claims 1 and 4-7 in Claim Group I is allowable over the cited prior art and that the rejection of these claims should be overturned.

Discussion of Claim Group II

Claim 8

Claim 8 presently stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Greene et al.* in view of *Sudarsky* in further view of *Greene*. Claim 8 reads as follows on the next page:

> 8. The apparatus of claim 7, wherein the primitives are occlusion tested in a tiler component of the graphics system and wherein ***the Z pyramid data structure is updated by the tiler component on the fly as primitives are being processed through the graphics system***.

(Emphasis Added).

Applicant respectfully asserts that the combination of *Greene et al.* ('455) in view of *Sudarsky* in further view of *Greene et al.* ('763) is inadequate to render pending claim 8 obvious. In particular, the combination fails to disclose, teach, or suggest at least the emphasized features of independent claim 1 and the emphasized features of claim 8 highlighted above.

First, Applicant submits that independent claim 8 is narrower in scope than allowable independent claim 1 in that it contains the highlighted features referenced above in addition to the features of allowable claim 1. Specifically, dependent claim 8 more particularly claims, "**. . .*the Z pyramid data structure is updated by the tiler component on the fly as primitives are being processed through the graphics system.***" Applicant respectfully submits that the emphasized elements of claim 1 and claim 8 are not taught, suggested or disclosed in the cited prior art.

Specifically, the rejection alleges: "Greene et al. ('763) discloses the primitives) are occlusion tested in a tiler component of the graphics wherein the Z pyramid data is updated by the tiler on the fly as the primitives are being processed through the graphics system (col. 6, lines 29-40)." The Final Office Action Rejection then concludes, "It would have been

obvious to one of ordinary skill in the art to include a "tiling pass" as taught by Greene, because tiling pass (very rapidly) has culled most of the hidden polygons it could improve in updating or inserting the remaining polygons into the quadtree (Z pyramid)." Applicant respectfully disagrees with this reading of the '763 patent.

The *Greene et al.* reference (the '763 patent) is directed to a method to prevent aliasing in a color display containing complex geometrical shapes. In this regard, the '763 patent refers to and includes by reference the entire contents of the *Greene et al.* '455 patent. The portion of the '763 patent that the Final Office Action relies on is repeated below for convenience.

> FIG. 5B is used to illustrate quadtree subdivision of an image plane driven by the complexity of visible geometry, which is similar to the subdivision performed by the antialiased rendering algorithm of the present invention described below during a "tiling pass." As illustrated, the example shows 5 levels of subdivisions A-E, i.e., until no more than two primitives are visible in a quadtree cell Q. In the "tiling pass" of the algorithm of the present invention, the quadtree cells are subdivided whenever more than some fixed number of primitives, e.g. 10, are determined to be visible.

Applicant respectfully submits that the relied upon reference does not disclose, teach, or suggest to one skilled in the art how to make the Applicant's claimed invention as recited in independent claim 1 (see above) and does not disclose, teach, or suggest the additional elements of dependent claim 8, which depends therefrom. Applicant submits that the rejection of claim 8 is improper and should be overturned.

Furthermore, there is presumed to be a difference in meaning and scope when different words or different phrases are used in separate claims. The doctrine of claim differentiation states the presumption that the difference between claims is significant. *Tandon Corp. v. U.S. International Trade Commission*, 831 F.2d 1017, 4 U.S.P.Q.2d 1283 (Fed. Cir. 1987). The Office Action has failed to recognize this legal doctrine. For at

least the reason that dependent claim 8 is narrower in scope than allowable independent claim 1. Applicant submits that the rejection of claim 8, as presently set forth, should be overturned.

Moreover, since the Final Office Action failed to establish a *prima facie* case of obviousness for each feature of pending claim 8, Applicant respectfully submits that the rejection of claim 8, as presently set forth, is improper and should be overturned.

Claims 9-10

Claims 9-10 presently stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Greene et al.* in view of *Sudarsky*. Applicant submits that the pending dependent claims 9-10 contain all the features of their respective independent claim 1 and dependent claim 8 from which both depend. Because both claim 1 and claim 8 are allowable, as argued above, pending dependent claims 9-10 are allowable as a matter of law for at least this reason. *In re Fine, supra.*

Furthermore, under the doctrine of claim differentiation, dependent claims 9 and 10 are narrower in scope than allowable independent claim 1 and allowable dependent claim 8 from which both depend. Therefore, Applicant submits that the rejection of claims 9 and 10, as presently set forth, should be overturned.

Moreover, since the Final Office Action failed to establish a *prima facie* case of obviousness for each feature of claims 9 and 10, Applicant respectfully submits that the rejection of claims 9 and 10, as presently set forth, is improper and should be overturned.

Discussion of Claim Group III

Claim 11

Claim 11 presently stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Greene et al.* in view of *Sudarsky*. Claim 11 recites:

> 11. A method for occlusion testing primitives in a graphics system, each primitive having a minimum Z value and a maximum Z value, the method comprising the steps of:
>
> generating a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level;
>
> comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded;
>
> if a determination is made that the tested primitive is not fully occluded, determining whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive;
>
> if a determination is made that a subregion is fully covered by the tested primitive, determining whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion; and
>
> ***if a determination is made that the maximum Z value of the primitive is less than the Z value for the covered subregion, replacing the Z value for the subregion with the maximum Z value of the primitive.***

(Emphasis added).

Accordingly, Applicant's claim defines a method for occlusion testing primitives in a graphics system. A Z pyramid memory element is used to store a Z pyramid data structure that permits occlusion testing while primitives are being processed by the graphics system. With regard to independent claim 11 and as noted above with regard to independent claim 1, the Office Action rejection of all three independent claims 1, 11, and 18 is identical. In this

regard. Applicant respectfully asserts that the combination of *Greene et al.* ('455) in view of *Sudarsky* is inadequate to render claim 11 obvious.

First, Applicant submits that independent claim 11 is significantly different from independent claim 1 in that it is directed to method steps and not the apparatus of claim 1. Furthermore, independent claim 11 contains the highlighted features referenced above which are not disclosed, taught, or suggested in the cited prior art. More specifically, independent claim 11 recites, "***if a determination is made that the maximum Z value of the primitive is less than the Z value for the covered subregion, replacing the Z value for the subregion with the maximum Z value of the primitive.***" In this regard, the Final Office Action has wholly failed to cite the specific manner in which the proposed combination of the cited prior art teaches, suggests, or motivates, in such a way as to disclose the Applicant's presently-claimed invention.

For at least the reason that independent claim 11 is directed to method steps that contain patentable features that are not taught, suggested or disclosed in the cited prior art, Applicant submits that the rejection of claim 11, as presently set forth, should be overturned.

Moreover, since the Office failed to establish a *prima facie* case of obviousness for each feature of pending claim 11, Applicant respectfully submits that the rejection of claim 11, as presently set forth, is improper and should be overturned.

Claims 14-17

Since claim 11 is allowable, as argued above, pending dependent claims 14-17 are allowable as a matter of law since they contain all features of their respective independent claim. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988). Therefore, Applicant respectfully asserts that the rejection of dependent claims 14-17 is improper and requests that this rejection be overturned.

Discussion of Claim Group IV

Claim 18

Claim 18 presently stands rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Greene et al.* ('455) in view of *Sudarsky*. Claim 18 recites:

> 18. An apparatus for occlusion testing primitives being processed in a graphics system, each primitive having a minimum Z value and a maximum Z value, the apparatus comprising:
>
> ***means for creating*** a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level; and
>
> ***means for comparing*** the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded, wherein if a determination is made that the tested primitive is not fully occluded, said comparing means determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if said comparing means determines that a subregion is fully covered by the tested primitive, then said comparing means determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion, ***wherein if said comparing means determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then said comparing means replaces the Z value for the subregion with the maximum Z value of the primitive***.

(Emphasis added).

Applicant's claim defines an apparatus for occlusion testing primitives in a graphics system. A Z pyramid memory element is used to store a Z pyramid data structure that permits occlusion testing while primitives are being processed by the graphics system.

With regard to independent claim 18 and as noted above with regard to independent claims 1 and 11, the Office Action rejection of all three independent claims 1, 11, and 18 is

identical. In this regard, Applicant respectfully asserts that the combination of *Greene et al.* ('455) in view of *Sudarsky* is inadequate to render claim 18 obvious.

First, Applicant submits that the emphasized elements are set forth in means plus function format. Pursuant to 35 U.S.C. § 112(6), a claim element recited in means-plus-function format "shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof." 35 U.S.C. § 112, ¶ 6. The Federal Circuit has clearly endorsed this statutory mandate by holding that claims interpreted under 35 U.S.C. § 112, paragraph 6, are limited to the corresponding structure disclosed in the specification and it equivalents. *Kahn v. General Motors Corp.* 135 F.3d 1472, 45 U.S.P.Q.2d 1608 (Fed. Cir. 1998).

There should be no question but that the elements recited in claim 18 are to be construed pursuant to 35 U.S.C. § 112, paragraph 6. In *Greenberg v. Ethicon Endo-Surgical Inc.*, 91 F.3d 1580, 39 U.S.P.Q. 2d 1783 (Fed. Cir. 1996), the Federal Circuit stated that the use of "means for" language generally invokes 112(6). Indeed, only if means plus function claim elements recite sufficient structure to carry out the function will the presumptive application of 35 U.S.C. § 112, paragraph 6 be overcome. *Cole v. Kimberly-Clark Corp.*, 102 F.3d 524, 41 U.S.P.Q.2d 1001 (Fed. Cir. 1996).

Indeed, the Federal Circuit reiterated in *Sage Products, Inc. v. Devon Industries, Inc.*, 126 F.3d 1420, 44 U.S.P.Q.2d 1103 (Fed. Cir. 1998) that "the use of the word 'means,' which is part of the classic template for functional claim elements, gives rise to 'a presumption that the inventor used the term advisedly to invoke the statutory mandates for means-plus-function clauses." Ultimately, the Court in *Sage* construed the relevant claim elements under 35 U.S.C. § 112(6), because 'means' were recited, and the claim elements did not "explicitly recite[s] the structure, material, or acts needed to perform the [recited] functions. *Sage* at p. 1428. The Federal Circuit further acknowledged this presumption in

Al-Site Corp. v. VSI International, Inc., 174 F.3d 1308, 50 U.S.P.Q.2d 1161 (Fed. Cir. 1999).

Thus, claim elements expressed in "means" plus function format are construed is determined in accordance with 35 U.S.C. § 112, paragraph 6, as set forth above, and as further described in *In re Donaldson* 16 F.3d 1189, 29 U.S.P.Q.2d 1845 (Fed. Cir. 1994)(*en banc*). Therefore, the various "means" elements must be construed in accordance with the structure set forth in the present specification. In this regard, the Federal Circuit, held, as a matter of law, that "one construing means-plus-function language in a claim must look to the specification and interpret that language in light of the corresponding structure ... described therein, and equivalents thereof. *In re Donaldson* at 1848.

Thus, the means plus function elements of claim 18 must be construed more narrowly than the corresponding elements of claim 1. Therefore, the rejection of claim 1 does not necessarily apply to claim 18. The Office Action, however, failed to differentiate the rejection of claims 1 and 18. For at least this reason, Applicant submits that the rejection of claim 18 should be overturned, as it is incomplete and legally deficient.

Furthermore, independent claim 18 contains the highlighted features referenced above which are not disclosed, taught, or suggested in the cited prior art. More specifically, independent claim 18 recites, "***wherein if said comparing means determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then said comparing means replaces the Z value for the subregion with the maximum Z value of the primitive.***" In this regard, the Final Office Action has wholly failed to cite the specific manner in which the proposed combination of the cited prior art teaches, suggests, or motivates, in such a way as to disclose the Applicant's presently-claimed invention.

For at least the reasons noted above, *i.e.*, independent claim 18 is directed to means plus function elements that contain patentable features that are not taught, suggested or

disclosed in the cited prior art and that the rejection of claim 18 is legally deficient. Applicant submits that the rejection of claim 18, as presently set forth, should be overturned.

Moreover, since the Office failed to establish a *prima facie* case of obviousness for each feature of pending claim 18, Applicant respectfully submits that the rejection of claim 18, as presently set forth, is improper and should be overturned.

CONCLUSION

Applicant respectfully requests that the Board of Appeals reverse the Final Office Action's rejections of all pending claims 1, 4-11, and 14-18 for the reasons indicated.

Respectfully submitted,

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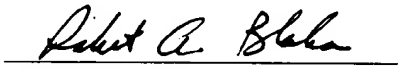
By: 

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APPENDIX TO THE APPEAL BRIEF UNDER 37 C.F.R. §1.192

The Appendix is incorporated into the foregoing Appeal Brief under 37 C.F.R. §1.192.

THE CLAIMS

1. An apparatus for occlusion testing primitives being processed in a graphics system, each primitive having a minimum Z value and a maximum Z value, the apparatus comprising:

logic configured to create a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level, said logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded, wherein if a determination is made that the tested primitive is not fully occluded, said logic determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if said logic determines that a subregion is fully covered by the tested primitive, then said logic determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive, wherein said logic to determines whether the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion, wherein if said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then the Z value for the covered subregion is replaced with the maximum Z value of the primitive.

4. The apparatus of claim 1, wherein said logic maintains a coverage mask for each level of the Z pyramid data structure, each coverage mask comprising a bit for each subregion of the level of the Z pyramid data structure associated with the coverage mask, wherein when said logic determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, a bit in the coverage mask associated with the covered subregion is set.

5. The apparatus of claim 4, wherein when all of the coverage mask bits corresponding to the subregions of a particular region have been set in the coverage mask associated with the first level of the Z pyramid data structure, a bit is set for the corresponding region in the coverage mask associated with the second level up in the Z pyramid data structure.

6. The apparatus of claim 5, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, said logic replaces the maximum Z value for the particular region with the maximum Z value of all of the subregions associated with the particular region.

7. The apparatus of claim 6, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, said logic sets the corresponding bit in the coverage mask for a next level up in the Z pyramid.

8. The apparatus of claim 7, wherein the primitives are occlusion tested in a tiler component of the graphics system and wherein the Z pyramid data structure is updated by the tiler component on the fly as primitives are being processed through the graphics system.

9. The apparatus of claim 8, wherein the graphics system is comprised as part of a computer graphics display system, the tiler component being in communication with a Z pyramid memory element, the Z pyramid memory element storing the Z pyramid data structure.

10. The apparatus of claim 9, wherein the Z pyramid memory element is periodically updated with pixel level Z values, the pixel level Z values corresponding to Z values of primitives which have been scan converted into screen coordinates corresponding to locations on the display monitor, and wherein the pixel level Z values are used by the tiler component to periodically reconstruct the Z pyramid data structure.

11. A method for occlusion testing primitives in a graphics system, each primitive having a minimum Z value and a maximum Z value, the method comprising the steps of:

generating a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level;

comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded;

if a determination is made that the tested primitive is not fully occluded, determining whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive;

if a determination is made that a subregion is fully covered by the tested primitive, determining whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion; and

if a determination is made that the maximum Z value of the primitive is less than the Z value for the covered subregion, replacing the Z value for the subregion with the maximum Z value of the primitive.

14. The method of claim 11, further comprising the step of:

maintaining a coverage mask for each level of the Z pyramid data structure, each coverage mask comprising a bit for each subregion of the level of the Z pyramid data structure associated with the coverage mask, wherein when a determination is made that the maximum Z value of the primitive is less than the Z value for the covered subregion, a bit in the coverage mask associated with the covered subregion is set.

15. The method of claim 14, wherein when all of the coverage mask bits corresponding to the subregions of a particular region have been set in the coverage mask associated with the first level of the Z pyramid data structure, a bit is set for the corresponding region in the coverage mask associated with the next level up in the Z pyramid data structure.

16. The method of claim 15, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, the maximum Z value for the particular region is replaced with the maximum Z value of all of the subregions associated with the particular region.

17. The method of claim 16, wherein when all of the bits in the coverage mask have been set for a particular region in the coverage mask, the corresponding bit in the coverage mask is set for a next level up in the Z pyramid.

18. An apparatus for occlusion testing primitives being processed in a graphics system, each primitive having a minimum Z value and a maximum Z value, the apparatus comprising:

means for creating a Z pyramid data structure, the Z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions, each region comprising a plurality of subregions, each subregion corresponding to a single Z value, each region corresponding to a plurality of Z values and having a maximum region Z value corresponding to the greatest of the Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level; and

means for comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded, wherein if a determination is made that the tested primitive is not fully occluded, said comparing means determines whether or not any subregion of the region associated with the tested primitive is fully covered by the primitive, wherein if said comparing means determines that a subregion is fully covered by the tested primitive, then said comparing means determines whether or not the Z value of the covered subregion needs to be replaced with the maximum Z value of the tested primitive by determining whether or not the maximum Z value of the tested primitive is less than the Z value for the covered subregion, wherein if said comparing means determines that the maximum Z value of the primitive is less than the Z value for the covered subregion, then said comparing means replaces the Z value for the subregion with the maximum Z value of the primitive.